CDS-687

SILICONES Digest

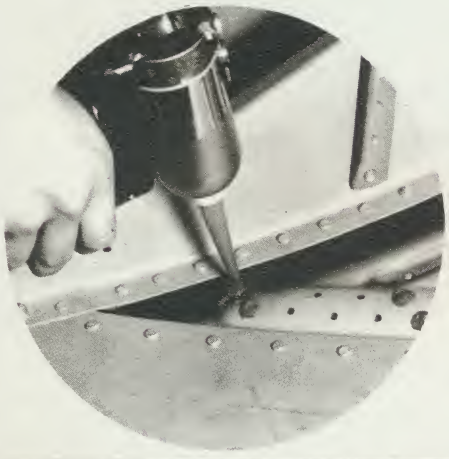
VOL. 3, FALL, 1965

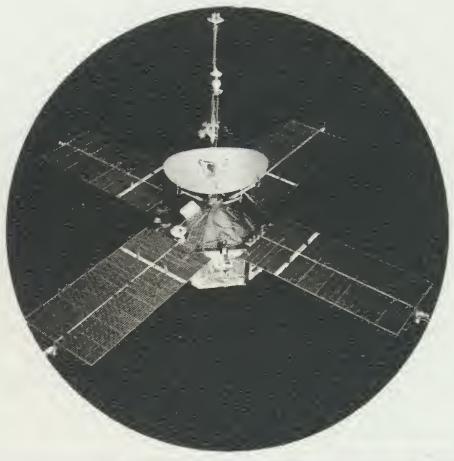
SPECIAL REPORT

the new Generation

RTV

Silicones





GENERAL ELECTRIC

SILICONE PRODUCTS DEPARTMENT

WATERFORD, NEW YORK

NEW-GENERATION PROBLEM-SOLVERS FOR NEW-GENERATION PROBLEMS

The brisk pace of developments in RTV silicone rubbers has always made comprehension of their total impact difficult.

The recent pace has been particularly explosive, necessitating one of those "long looks" which are occasionally required to sort out the things which are of the most far-reaching value.

This special 20-page issue of Silicones Digest is designed to focus on those recent developments with emphasis on the new capabilities which they offer to the engineer.

SILICONES Digest

VOL. 3, FALL, 1965

L. W. MAHAR Editor

Published periodically and distributed without charge by the Silicone Products Department of the General Electric Company: Fred J. Borch, Pres. & Chief Executive Officer; Gerald L. Phillippe, Chairman of the Board; 570 Lexington Ave., New York, N. Y.

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G.E. Silicones Digest

Silicone Products Department

General Electric Company

Waterford, N. Y.

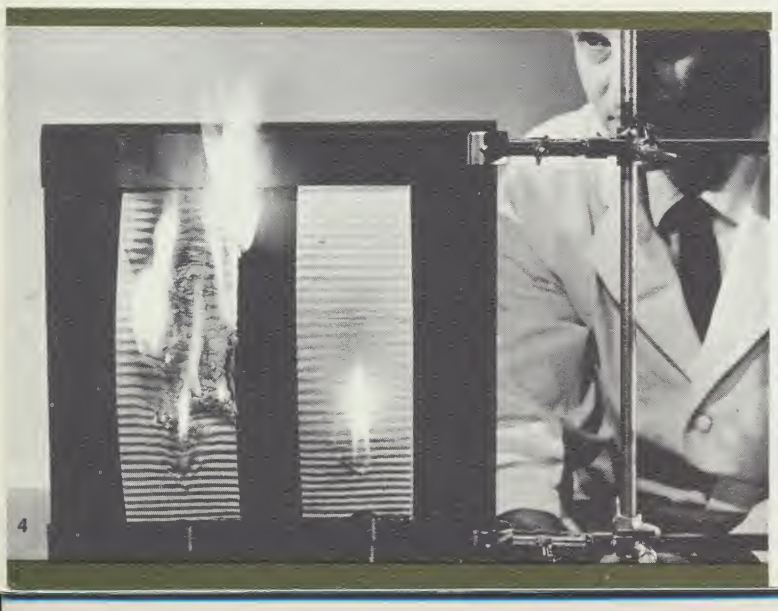
OUR COVER — New products are the lifeblood of the silicone industry. Development has moved ahead at such a pace that about half of today's silicone products did not exist five years ago. Featured in the top row of the cover are photos of three products that did not exist five months ago. These photos are set off against a series of other photos showing uses for these new materials as well as some new uses for some previous RTV silicones.

SPREAD ON AS PASTE...

This NEW Fire Resistant Silicone Rubber

FOAMS IN PLACE — New flame-resistant silicone rubber compound, developed by General Electric's Silicone Products Department, can be applied to walls of aircraft, marine and ground equipment to form a lightweight foamed rubber firewall blanket. Identified as RTV-757, the material is applied as a paste. On application of heat, the compound cures to a lightweight foam rubber.

PAINT-ON RUBBER FIRE BARRIER — Spread on, product foams and cures on application of heat to a rubbery firewall blanket that resists flame and provides thermal insulation to cabin areas of aircraft, marine and ground vehicles. Shown after one minute exposure to flame, RTV-757 is unaffected, while previous silicone compound, left, is consumed. Material is lightweight and has good buoyancy in water.



A new flame-proof silicone rubber that foams and cures in place to form a lightweight thermal insulating blanket has been developed by General Electric Company.

The new material, identified as RTV-757 silicone rubber foam, is capable of providing protection for compartments in aircraft, tanks, ships and stationary equipment from intense flames.

Shown for the first time at National Symposium of the Society of Materials and Process Engineers Meeting at San Francisco recently, by General Electric's Silicone Products Department, Waterford, New York, RTV-757 is a thixotropic paste which can be foamed over a surface and forms a tough, lightweight shield of rubber which provides protection from heat and combustion. It's cure from a tacky paste to a rugged sponge takes place in minutes during the foaming process, which is activated by passing a heat gun over the surface.

It is designed for use as a firewall blanket, fuel tank insulation, an ablative heat sheild and also as a potting and encapsulating compound; however, its flame resistant properties suggest usefulness in any application where protection from flame and heat is desirable. Its cellular construction gives it excellent buoyancy in water.

When subjected to a flame test, RTV-757 specimens (½″ x 6″ x ¾″) suspended vertically within a 2½″ diameter glass chimney and subjected to a 2000°F gas flame for 20 seconds do not ignite or otherwise support flame. Following the test no material cracking or loss of flexibility is noted. Under unconfined conditions RTV-757 specimens (¼″ x ½″ x 6″) bonded to metal panels and exposed to a 2000°F flame at a 45° angle for 15 minutes fail to propagate a flame.

RTV-757 can be applied to walls, fusilages, fuel storage tanks and ablating surfaces by a spatula or other type of spreading instrument. Following its

Cures to a tough Flame Resistant Blanket

HALTS SPREAD OF HEAT, FIRE — Paperboard container coated with RTV-757 silicone rubber is placed bottom side up over flower. A 5000°F oxy-acetylene flame is then put to bottom of container and held in position for one minute. Flame is taken away and flower is examined and found to be undamaged. Temperature inside went from 71°F to a modest 84°F despite intense flame, demonstrating capability of new material to provide protection from heat and flame.

application, forced hot air of approximately 100°C causes it to foam. It cures to a sponge-like blanket of 0.7 to 0.8 density. It bonds to nearly any primed surface.

RTV-757 is off-white to grey in color.

Much tougher than previous silicone rubber foams, the material in cured form has tensile strength of 250; thus approaching that of some solid stocks.

RTV-757 is a methyl phenyl silicone rubber. In cured form it provides the ultimate in low temperature flexibility (below -150°F).

Compound and curing agent kit is priced at $9.50 lb. in quantity. The material is available in full commercial quantities Evaluation samples are available. (Circle S-3C-3 on P. 20 for Technical Data).

INTEREST FROM MANY QUARTERS

Since the announcement of RTV-757, wide interest from many areas is confirming early hopes that the new material would fill urgent material needs in diverse kinds of engineered and manufactured equipment. The product is now being thoroughly evaluated as: thermal insulation for rocket support equipment; fire resistant shield in critical areas of jet aircraft; and in protective garments.

An area of major study is the manufacture of fuel tanks where RTV-757 shows promise of providing a fully fire resistant fuel storage capability for equipment using combustion engines.

TYPICAL PROPERTIES — RTV-757

UNCURED PROPERTIES

Color	White
Consistency	Thixotropic Paste (easily spread)
Solids Content — Nominal (contains no solvents)	100%
Specific Gravity at 77 F	1.3
Curing Agent Added	10 Weight % RTV-757B
Work Life at 77 F	6 Hours
Flow, Inches (after 2 Hours)	0.5
Application Rate — Grams/Minute Semco — 90 psi — 1/8" Orifice	
Initial	360
After 2 Hours	240
After 4 Hours	165
After 6 Hours	130

CURED PROPERTIES — FOAMED RUBBER

RTV-757A mixed with 10 weight percent RTV-757B cured 15 minutes at 300 F. Note: Properties obtained on controlled foamed specimens (6" x 6" x 1/4"). Free foamed conditions provide similar physical and density properties.

Color	White
Specific Gravity at 77 F	0.70
Density, lbs/ft^3	44
Hardness, Shore A	40
Tensile Strength, psi	250
Elongation, %	50
Tear, Lb/In.	20
Low Temperature Flexibility	Below — 150 F

THERMAL PROPERTIES

RTV-757 Foamed Sheet 4" x 4" x 1/4"
Sp. Gr. 0.80 — Test Temperature Range: 90°F-210°F

Thermal Conductivity (K)	0.09	BTU - ft. / hr., ft.^{2}, °F

ADHESION

Tested at 77 F. Specimens primed with SS-4120 and bonded to primed 304 stainless steel 20 mesh screen. Material free foamed/cured 15 minutes at 300 F.

Substrate	Lap Shear	Cohesive Failure
	psi	%
301 Stainless Steel		
After 7 Days at 77 F	125	100
After 7 Days at 400 F	180	100
Titanium #MIL-T-9046		
After 7 Days at 77 F	100	100
After 7 Days at 400 F	180	100
Alclad Aluminum[1]		
After 7 Days at 77 F	110	100
After 7 Days at 400 F	175	100

CHEMICAL STABILITY

RTV-757 bonded to metal panels. Free foamed cure, 15 Min. at 300 F.

Skydrol[2] 500 A (7 Days Total Soak at 77 F)	
Weight Change	+30%
Adhesion	Excellent Bond
Lap Shear	
Stainless Steel	100 psi 100% Cohesion
Aluminum	90 psi 100% Cohesion
Titanium	80 psi 100% Cohesion
Moisture — 95 Percent R.H., 120 F (7 Days Total Soak)	
Adhesion	Excellent Bond
Weight Change, %	+15

FUEL/OIL STABILITY

(RTV-757 Foamed Specimens — Sp. Gr. 0.8)

	Fluid (Fuel)			Fluid (Silicone Oil)	
	Jet Reference	Mil-S-3136	JP-4	JP-5	F-50
(Total Soak: 70 hrs. @ 160°F)					
Volume Change %	65	60	55	50	15
Weight Change %	90	80	90	80	55

	ASTM #1	ASTM #3
(Total Soak: 70 hrs. @ 300°F)		
Volume Change %	3	35
Weight Change %	15	90

ROCKET FUEL COMPATIBILITY

(RTV-757 — 1/4" Foamed Specimen Bonded to Aluminum)

Environment	Test Condition	Results
Oxidizer Splash	One Minute Total Immersion in N_2O_4 Liquid	• Moderate Discoloration • Slight Surface Hardening • Foamed Flexibiity Maintained • Physical Properties Unchanged • Excellent Adhesion
Oxidizer Fumes	One Hour Exposure to Concentrated N_2O_4 Fumes	• Slight Discoloration • Foamed Rubber Properties Unchanged • Slight Adhesion Loss
Fuel Splash	One Minute Immersion in Hydrozine/ UDMH Fuel	• No Discoloration • Foamed Rubber Properties Unchanged • Excellent Adhesion

[1]Alclad Aluminum Screening, Trademark, Dixie Screen & Wire Products Co., Florence, Ala.

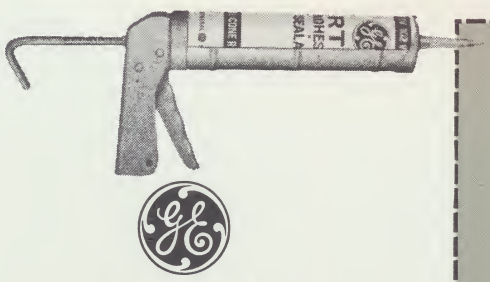
[2]Skydrol Functional Fluid, Trademark, Montsanto Co., St. Louis, Mo.

speeds production-line sealing at lower cost

Get General Electric silicone rubber adhesive sealants in a better package! Get G-E white RTV-102 and translucent RTV-108 at a new low price! And get a handy dispenser gun FREE with your trial purchase!

RTV-102 and RTV-108 are now in new 6 and 12 ounce cartridges designed for use in standard or air-powered caulking guns to speed and simplify productionline sealing operations. Ideal for electrical, electronic, aerospace and general industrial applications such as sealing terminal connections, weatherproofing, caulking, patching . . . and virtually any application requiring a flexible, durable adhesive bond.

These RTV compounds are ready to use with no mixing required. Their new cartridge-pack makes it a cinch to get into confined areas and hard-to-reach spots. RTV sets in minutes, cures in a few hours . . . will not sag, flow, shrink, crack, harden or peel . . . at temperatures from —75°F to above +300°F. Ingredients in these RTV compounds meet Federal Food and Drug Administration requirements for use in any application where they might incidentally come in direct contact with food. All in all, there are probably 1000 production problems you can solve . . . permanently . . . with these RTV's.



GENERAL ELECTRIC

SPECIAL INTRODUCTORY OFFER
FOR DIGEST READERS ONLY

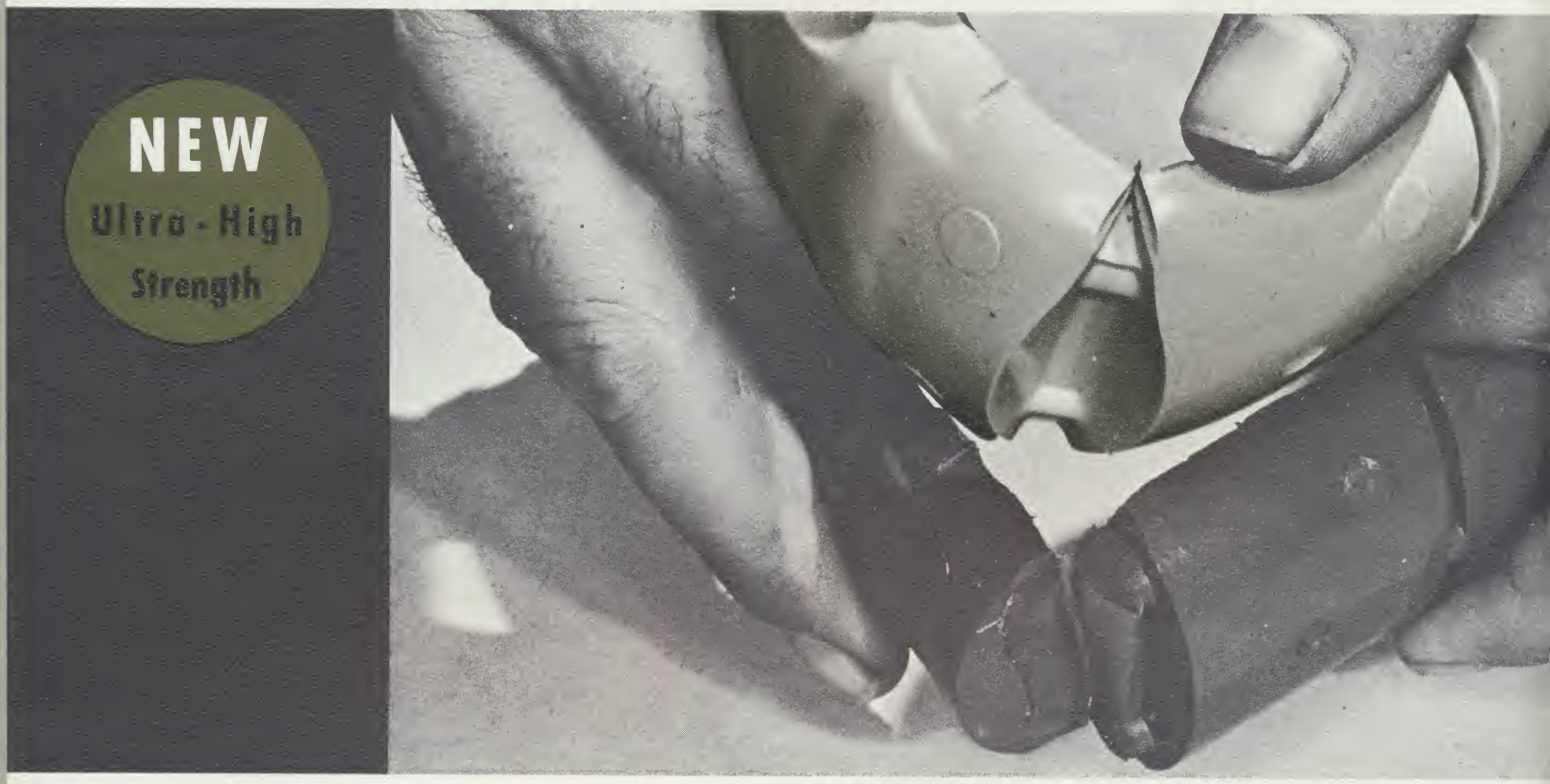
Twelve ounce cartridge of RTV-108 (translucent) or RTV-102 (white) at the new low $3.27* price. Get yours by sending company purchase order to General Electric Company, Silicone Products Department, P. O. Box 385, Schenectady, N. Y.

OFFER ENDS JANUARY 1, 1966

*Plus applicable state or local tax.

New RTV Silicone is 100% Stronger

RTV-630 is Key to improved



TOUGH SILICONE COMPOUND — Flexible silicone rubber mold, top, made of new RTV silicone compound (RTV-630), can be bent double for an indefinite number of times without tearing, even when surface has been notched. This mold for appliance housing (top), was flexed 2500 times before picture was taken, with no visible effects. Mold, bottom, made of conventional RTV silicone rubber, ruptured and tore on initial flex.

A major break-through in silicone rubber technology has been achieved with the development of a new ultra-high strength liquid silicone rubber compound with better than twice the toughness of existing liquid silicone rubber materials.

The compound is identified as RTV-630 and utilizes more efficient polymer linkages than conventional liquid RTV silicone rubbers. This chemistry permits the new silicone to withstand greatly increased pressures at high temperatures, permitting more extensive use of the materials as a production tool.

The product is expected to have a major impact in three main areas: (1) as a production tool in various processes for casting and thermo-forming of plastics, (2) as a potting and encapsulating material for electronic and electrical components and assemblies; and (3) in the fabrication of silicone rubber parts where superior endurance is required. It should also find usefulness across the broad range of applications for liquid silicone rubbers throughout industry, where the improved toughness of the material should provide extended life expectancy with resulting cost savings.

processes and performance

Typical among these applications: As a rubber punch in production forming of re-inforced plastics at temperatures of 350°F and pressures of 5000 psi RAM load; an impression carrier for making embossing rolls used in texturing plastic films; a non-stick, high temperature resistant coating for conveyer belts used in processing and handling of tacky chemicals, foods and other products; high temperture sealant in manufactured machinery; and as a protective and insulating covering for products requiring isolation for extreme heat, moisture and other environmental extremes.

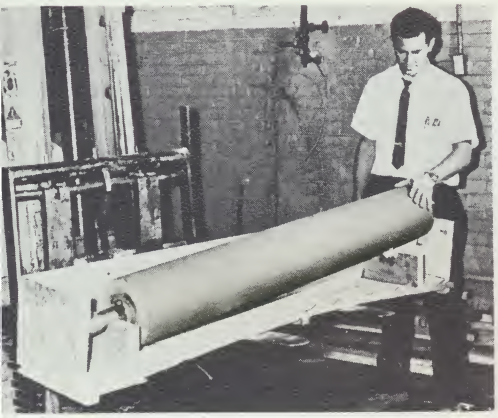
A pastel blue pourable liquid in uncured form, RTV-630 has a tear strength of approximately 100 lb./in., die B, which compares to about 40 for typical liquid silicone rubbers. The tear resistance of RTV-630 is *equal* to heat cured silicone rubber stocks. This is the first time that a liquid RTV silicone rubber has ever been produced that possessed a tear strength equal to a heat-cured compound.

Chemically, the new compound is an addition cured room temperature vulcanizing liquid silicone rubber containing an unique molecular crosslinking system.

The major experience with RTV-630 thus far has been in the plastic tooling field where, in the matched die molding of reinforced plastics, it successfully replaced a male metal die used to compression mold a polyester-fiberglass layup. Extended production runs at 350°F and 5000 psi pressure are being successfully made. This marks the first time a liquid silicone rubber has possessed sufficient properties to perform in such an application on extended runs.

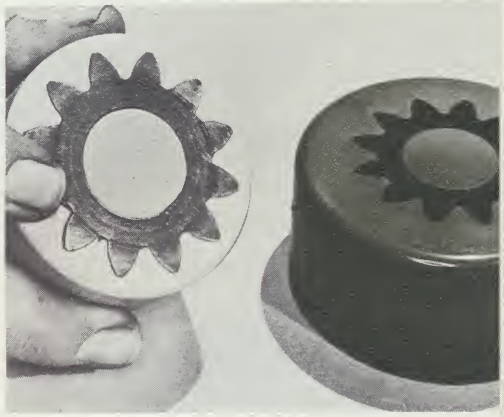
On another application under somewhat similar conditions, RTV-630 has been successfully made into a bladder for pressure bag molding of an epoxy fiberglass system.

In making flexible rubber molds for short run production of epoxy cast parts, RTV-630's improved toughness has resulted in molds with greater yield capabilities. It has been possible in some cases to obtain in excess of 100 percent increase in cast parts from molds made of RTV-630 without damage to the mold.

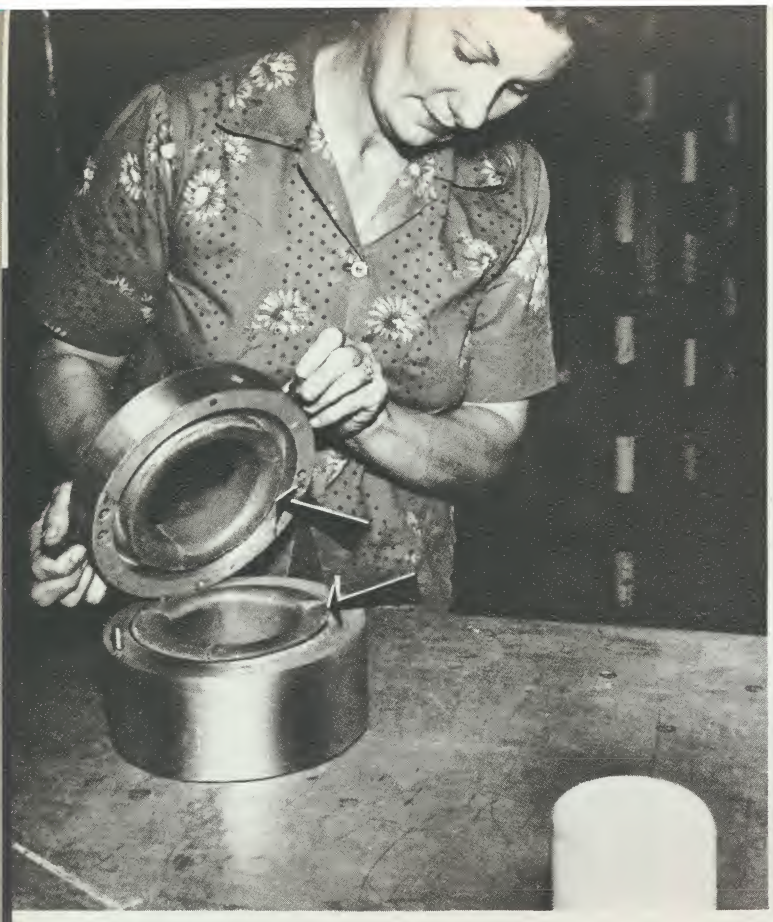


RUBBER EMBOSSING ROLLS FOR PLASTIC — New ultra-high strength liquid silicone rubber from General Electric Company (RTV-630) has indicated potential usefulness as an impression carrier for embossing rolls, replacing etched metal. Offering excellent high temperature resistance and strength, finish is transferred directly from artist's pattern to silicone rubber roll covering, eliminating intermediate steps. Roll shown is a production roll with silicone rubber face used in production of automotive head liner. Roll was made at a cost of about $200 and took less than 10 man-hours to produce. Comparable engraved steel roll would have cost approximately $3000 and would have required about 90 days for delivery.

FLEXIBLE PUNCH — RTV-630 has successfully been used as a rubber punch replacing metal in forming reinforced plastic parts on a production basis. In setup above, new RTV can be seen protruding from mated metal female die (arrow). Engineers at General Dynamics Corporation Ft. Worth Division have used the new silicone to produce structural parts for use in the Atlas missile and F-111 jet aircraft. Earlier developmental work with the RTV's showed promise that silicone could be used as a quick and inexpensive substitute for earlier methods, cutting production time by as much as one-third; however, RTV-630 is seen as the first candidate that could withstand long-term production exposure to 5000 psi RAM load at 350°F. (Courtesy General Dynamics Corp.)



ULTRA-HIGH STRENGTH RTV NETS ECONOMY — Due to improved strength of new General Electric RTV silicone rubber compound (RTV-630), thinner sections of material can be employed in applications, as in flexible mold at left, with significant cost savings. In addition, improved strength also more than doubles the life expectancy of flexible molds for casting epoxy parts which are made of new RTV silicone rubber. Superiority of compound in providing molds with greatly extended life expectancy has been demonstrated in production applications. Compound has twice the toughness of previous RTV silicone rubbers.



A LAMINATED PART processed with a silicone punch by General Dynamics Corporation engineers. Silicone reduces process time, all but eliminates post-machining. (Courtesy of General Dynamics Corp.)

DIE FOR REINFORCED PLASTICS — RTV-630 silicone rubber has been successfully used as a punch (lower right) in forming at 350°F and at 5000 psi RAM load epoxy part (indicated by arrow). Silicone dies make possible elimination of costly male metal punch dies; give added advantage of fast preparation, since they can be molded from a liquid rubber and cured in minutes at an elevated temperature. (Courtesy of General Dynamics Corp.)

EMBOSSED RUBBER — Detail shot shows embossing roll surface made of G-E RTV silicone rubber which has been cast directly from artist's master.

NEW Ultra-High Strength

(continued)

Elsewhere in plastics processing, a potential is seen for the new compound as an impression carrier in forming and texturing of plastic films in the manufacture of wallpaper, floor covering, plastic goods for women's accessories and other products. Here, the material replaces expensive etched embossing rolls. In one instance a silicone roll for production of plastic head liners for autos was produced in less than 10 man-hours at a cost of only $200. Comparable metal engraved roll would cost approximately $3000 and take 90 days for delivery. Compound may also find use on printing rolls.

Electrical properties of RTV-630, being typical of conventional silicone rubbers, indicate that the material will meet the need for an encapsulating compound for electronic components with improved ability to withstand rough handling.

RTV-630 is available commercially at $5.30 per lb. in multiple one-gallon quantities. Price includes catalyst. Samples are available on request. (Circle S-28 on P. 20 for Technical Data).

Physical Profile
RTV-630 Versus Previous Silicone Rubbers

	RTV-630	Typical Heat Cured Stock	Typical RTV
Tensile, psi	850	850	800
Elongation, %	300	300	130
Durometer Hardness, Shore A	70	70	60
Tear, die B lb./in.	100	90	40

One compound gives wide range of densities for...

An RTV (room temperature vulcanizing) liquid silicone rubber which cures to a flexible foam whose density can be changed by blending with standard liquid silicone rubber compounds, has been developed by General Electric. An unique feature of the material, RTV-7, is that it will cure and foam in extreme enviroments, even under water.

RTV-7 is designed as a compound which can be foamed on-the-spot to provide mechanical support, shock and vibration damping and for use as lightweight electrical insulation and low-density thermal insulation.

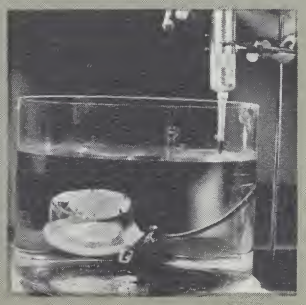
The material is supplied as an uncatalyzed black base compound of 7000-9000 centistoke viscosity. Thorough mixing of the product with a curing agent initiates curing and expanding action. Within 10 minutes foaming and curing are complete. Like other silicone rubber materials, the cured compound remains flexible at extremely low temperatures and resists extremely high temperatures (from -65 to 600°F). The curing and foaming process can take place in a variety of environments and has even been achieved in water, where RTV-7 generates an independent atmosphere which is capable of displacing water and buoying-up sunken objects.

When blended with standard RTV silicone rubber materials at selected concentrations of the latter below 20 percent, RTV-7 will cure to any one of a wide variety of densities. These features of the material are described in a paper by General Electric chemist Michael B. Sullivan, entitled "Modifications of Cellular RTV-Silicone Rubber".

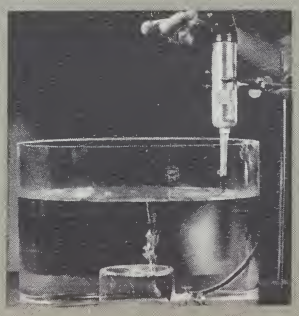
The compound is commercially available and evaluation samples are being supplied at $10 per lb. The compound is priced from $9.65 to $9.75 per lb., depending on quantity. A given quantity of RTV-7 will produce up to 5 times the starting volume. (For Product Data, circle RTV-7 on P. 20. For a copy of the paper on Cellular RTV Modifications, circle CDS-648).

MANY FOAMS IN ONE — New liquid RTV silicone rubber expands to form a spongey rubber up to five times its original volume following addition of curing agent.

1 . . . a small quantity of RTV-7 is poured into a caulking cartridge.



3 . . . silicone commences to expand into a foam rubber creating its own lighter-than-water atmosphere and continuing to displace water in the sunken vessel.



2 . . . RTV travels through hose to water-filled vessel sitting at bottom of tank. As silicone enters vessel, it begins to expand forcing water to exit.

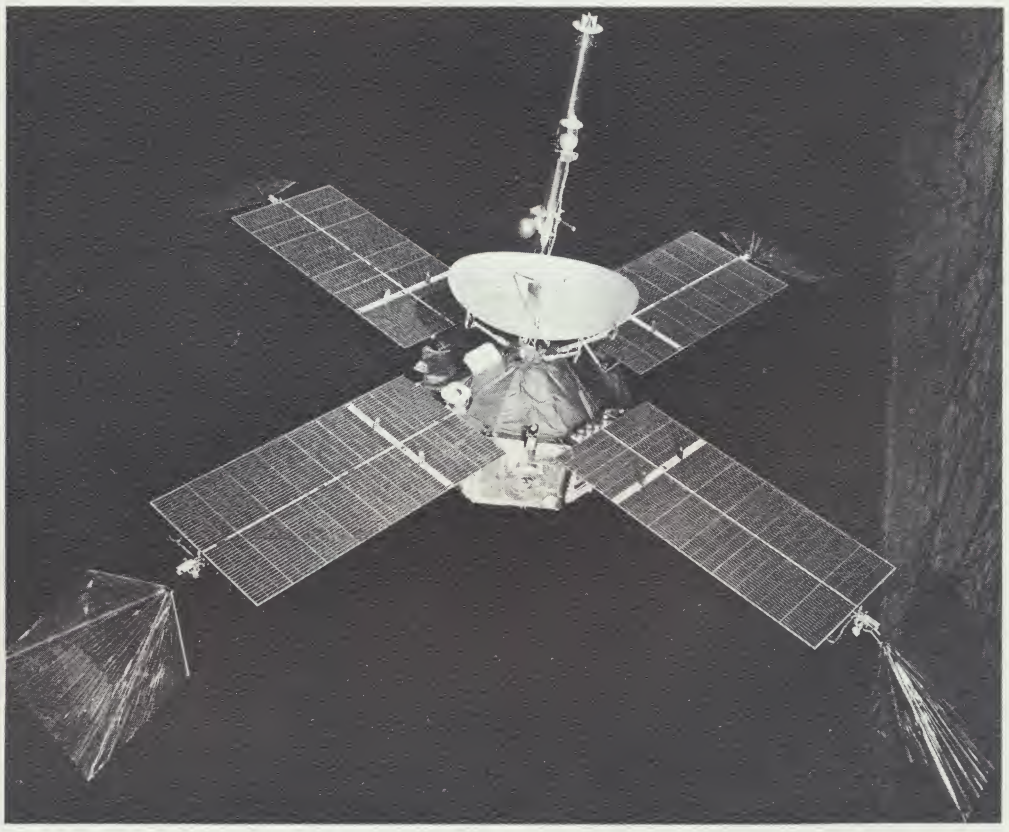
5 . . . by time vessel is removed from tank, silicone has expanded to the point where almost all of the water has been displaced.

4 . . . still only partially expanded, silicone sponge has displaced sufficient water to cause vessel to surface.

6 . . . removed from vessel moments later, silicone is found to be fully cured with reasonably uniform foam characteristics.

NEW ENGINEERING SOLUTIONS WITH RTV LIQUID SILICONE RUBBER

ADHESIVE for MARS



MARINER SPACECRAFT, which carried out mission to Mars, employed some 28,224 photovoltaic solar cells to produce electrical energy required to complete its mission. (Photo courtesy of Jet Propulsion Lab).

After repeated successes as a bonding agent in space probe equipment, RTV silicone rubber adhesives continue to be employed to obtain reliable bonds.

Increasing utilization of the materials is found in mounting solar cells and various kinds of instrumentation and shielding on spacecraft.

Jet Propulsion Laboratory engineers at Pasadena, California, who designed and built NASA's Ranger and Mariner spacecraft, have utilized the materials extensively in bonding solar cells into place.

In the case of the Mariner, RTV-40 silicone rubber, supplied by General Electric Company, is employed to mount 28,224 photovoltaic solar cells on four panels which faced the Sun during most of the flight to Mars. The cells cover an area of about 70 square feet.

Primary advantages of the silicone adhesive in this application: (1) the limited effect of temperature changes and tough environmental conditions (ozone, corona, sunlight, thermal stress), on the physical properties; (2) and the superior ability of silicones to retain their physical properties under such conditions during long-term flights.

In addition to the use of General Electric's RTV-40 silicone rubber, a red, opaque material, Jet Propulsion engineers also employ a G-E silicone compound identified as RTV-602 to bond glass panels over solar cells. RTV-602 cures to form a clear adhesive which does not interfere with heat and light transmittal. These glass panels serve as protective filters which reduce the amount of solar heat absorbed without interferring with energy conversion.

The lightweight panel structures that support the cells are made of thin-gauge aluminum approximating the thickness of kitchen foil. Panels are constructed of .0035-inch aluminum sheet formed into a corrugation that is bonded to the cell-mounting surface made of .005-inch sheet.

A DUAL PURPOSE COATING

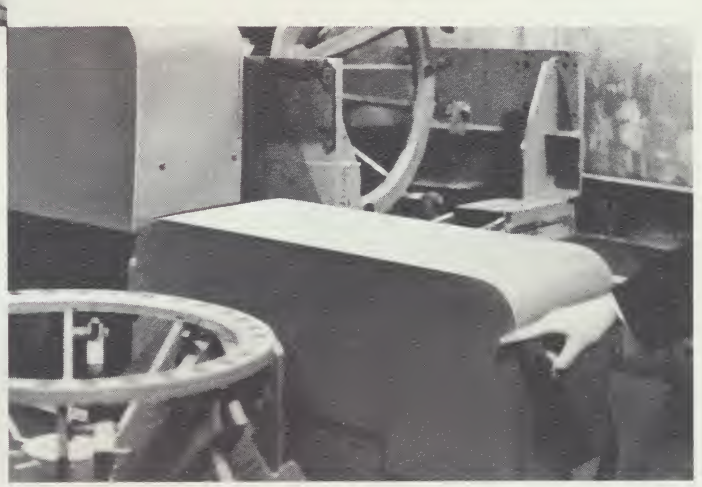
Support Structures in rocket test stands operated by United Technology Center in Coyote, California are protected from fire and resulting costly damage by an airtight blanket made of a resilient, heat resistant rubber.

The rubber, General Electric RTV-60 liquid silicone rubber, is applied by painting it on with a spatula in a thick layer over vital controls and instrumentation. Following application, the rubber cures to form a solid rubber blanket that protects against heat, shock, vibration, moisture and a variety of conditions. The material can thermally insulate for short periods of time at temperatures of many thousands of degrees F.

United Technology Center builds the Solid-Propellant booster motors for the Titan 3C Space Launch Vehicle at its production and test site at Coyote, Calif.

Process engineers at United Technology also employ G-E RTV-60 liquid silicone rubber as a tack resistant coating on equipment used in casting and processing solid rocket propellant and other sticky materials.

RUBBER BLANKETS STRUCTURES — Support structures in Titan III-C booster test stand are protected from fire and intense heat by a thick blanket of liquid silicone rubber, visible above as shiny finish on posts and cross fittings in center area beneath rocket base. (Courtesy United Technology Center.)

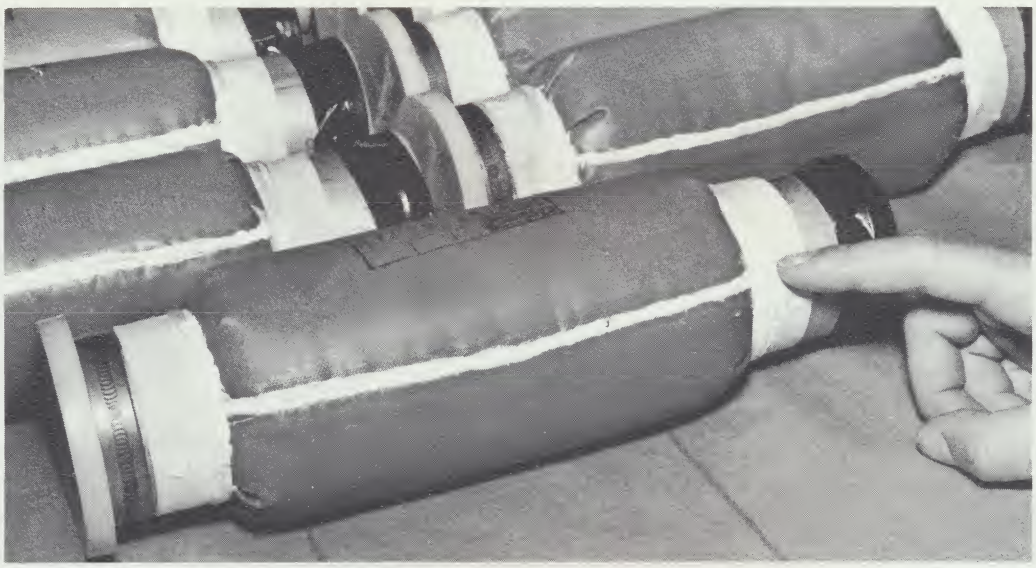


SAVES CLEANUP — "Paint" coating on this piece of equipment used for spin applications of a rubber liner material to solid propellant motor cases at United Technology Center in Sunnyvale, California consists of a General Electric-developed liquid silicone rubber, which has been sprayed into place on primed surface of the machine. RTV coating (RTV-60) cuts maintenance costs because tacky liner drops which land on machine during process do not stick to the finish.

FILMLIKE RELEASE COATING which enables easy separation of mandrels (above) from cured rocket propellant in the casting of boosters for Titan 3C missile is made of a liquid silicone rubber. Material, General Electric RTV-60 liquid silicone rubber, is sprayed on mandrel and allowed to cure to a tack-resistant rubber coating which makes separation from tacky propellant easy during the casting process.

NEW ENGINEERING SOLUTIONS WITH RTV LIQUID SILICONE RUBBER

SEALS "SUPER HOT" AIR

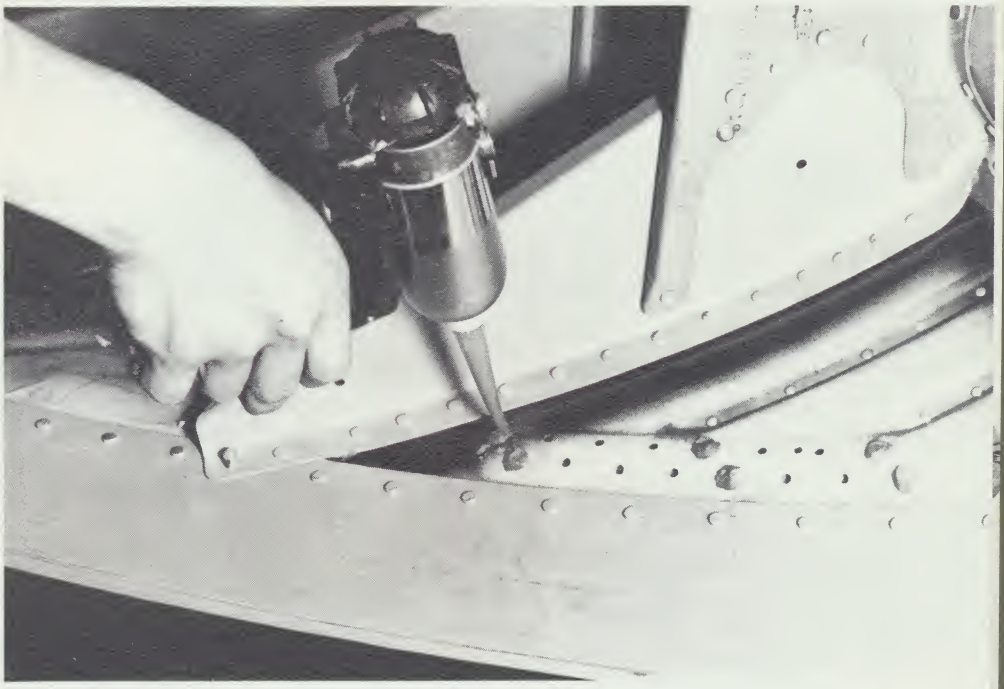


PRODUCTION SEALING of hot air ducts used in new Douglas DC-9 short to medium range transport is achieved with a silicone rubber compound, applied in paste-like form from a cartridge. Material, G-E's RTV-102 silicone rubber, cures in place to form a solid rubber that completely seals integral parts of the ducting as well as between sections and metal fixtures, where temperatures reach to 500°F and above. Excellent resistance of silicone to heat permits material to provide permanently flexible sealing for the lifetime of the unit. (Photo courtesy Douglas Aircraft Company).

POURED COVER GASKET

SELF-MADE GASKET — New rubber gasket for paint spray pot cover was made from liquid RTV silicone rubber. Silicone compound, General Electric's RTV-60, was painted into place and allowed to cure on primed surface to form seal (dark area on cover). Photo was taken at United Technology Center, Sunnyvale, California.

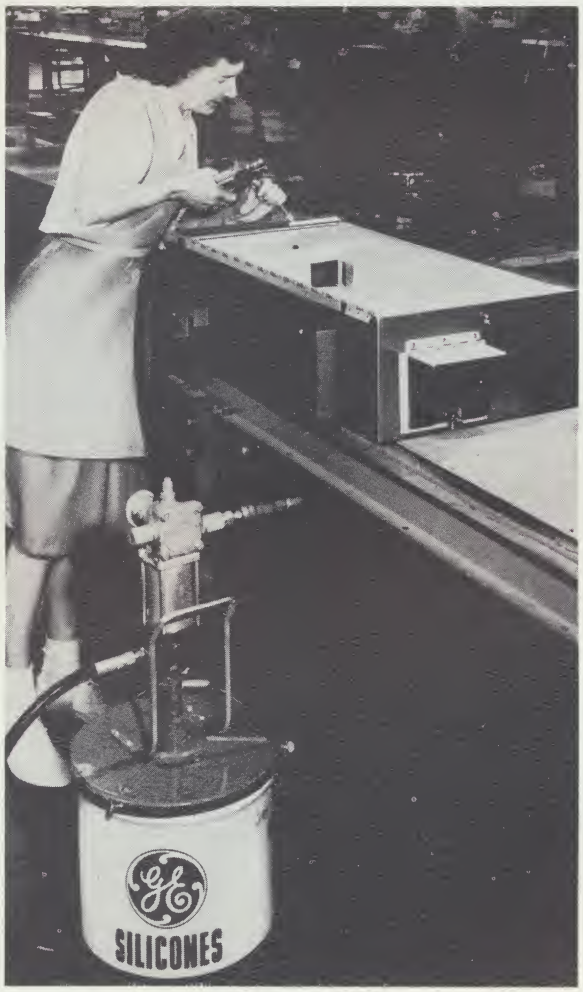
MODIFY AIR FLOW



RTV LIQUID silicone rubber compounds are frequently used to modify or correct flow of gases or air through plenum chambers in manufactured equipment. Above, G-E RTV-90 silicone rubber compound, a material of paste-like consistency which cures to a solid rubber at room temperature, is employed to reduce bleed of hot exhaust from Douglas DC-9 engine to wing edge to desired level by plugging bleed ports. (Photo courtesy Douglas Aircraft Company).

SEALS FUEL CELLS

SEAL FOR SPACE FUEL CELL — Bonding of rubber sponge "mask" to manifold tray of fuel cell battery coolant system is achieved with a General Electric RTV-102, indicated by white area on tray. The sponge helps to seal off critical cooling system components from moisture and contaminants. Silicone adhesive provides sturdy adhesion that resists thermal stress. Fuel cell battery was designed by G-E's Direct Energy Conversion Operation in Lynn, Mass. for the Gemini spacecraft. Cell battery has capability of operating for six weeks or equal to more than 750 earth orbits.



SEALED FOR GOOD

INCUBATOR SEALED — Air Shields' infant incubators use a silicone adhesive sealant developed by General Electric to form a permanently flexible seal between the hood and the incubator unit. The material is unaffected by sterilization in contrast to previous conventional sealants used which tended to dry out or crack with aging. Air Shields engineers note that loss of life-giving oxygen due to seal failure over long periods of service will be virtually eliminated through the use of the material.

AUTOMATED DISPENSING OF RTV

The steadily increasing number of applications for fluid plastics and elastomers in recent years has created a surging interest in room temperature vulcanizing (RTV) silicone rubbers. Once used solely in small hand-mixed quantities for laboratoy and shop, these materials (so named because they cure at room temperature from a liquid to a solid silicone rubber) have graduated into large volume, high-speed production systems. Their use in the electronics industry is especially significant where liquid silicone elastomers are among the foremost potting and encansulating materials used today.

When RTV applications involve a steady rate of use, requiring assembly line operation, or catalysis of more than one gallon at a time, some degree of automation is highly desirable. Automation offers convenience, is more economical and provides for improved processing uniformity and cleaner housekeeping.

There can be considerable variation with respect to the degree of process automation required and its cost of installation. The conversion may be as simple as a change-can mixer and cartridge loaded shot dispenser or it may be as involved as a system that meters, mixes, deaerates, applies and indexes parts at such high speeds as 30-40 parts a minute per head. Application of mixed, deaerated, multiple component RTV through flexible hoses attached to a hand held mix head, at rates up to one gallon a minute, is also possible. A measured shot or a continuous application of self curing adhesive from a 55 gallon reservoir (usable for several months after rigging and filling the pump) are other examples of what can be provided. Still more possibilities are application of as little as 0.20 g/shot $\pm$ 5% at 50 shots a minute, or use of an airless spray system to apply a 40 mil build-up on a large vertical surface in a single pass. It should be noted that, although the ratio of catalyst used with RTV is usually 1 to 200, machine systems work best with a paste catalyst ratio of 1 to 10 or similar ratios of an oil catalyst diluted with inert oil.

With the many manufacturers and numerous design principles in existence, it is sometimes difficult for a potential user to locate a competent source and obtain a satisfactory installation. This is especially true for those liquid polymer users who prefer silicones.

It is possible for people with experience in organic polymers to handle silicones incorrectly and not obtain the maximum performance and quality offered by these products. Silicones, it must be remembered, are inorganic materials. For example, if two-package RTV's are treated as organics, the user may fail to accurately meter the catalyst. An instance of this is found in the use of General Electric RTV which is prepared for 1/10 to 5/10 parts of catalyst for every 100 parts of compound (a special diluted version of catalyst must be used). Most organic materials, on the other hand, require a ratio of 4 or 5 parts catalyst to every 100 parts of compound. Again, one-package RTV cures by chemical reaction with atmospheric moisture; if the dispensing machine is not moisture-tight, the RTV may cure while it is still in the pump.

High viscosity organic compounds require immense pressures to force them through a dispensing machine. Equivalent viscosity silicone compounds, because of their different flow properties, may require lower pressure. In closed systems, the excellent flow and wetting properties of a silicone may enable the material to leak out at loose valves and joints. To avoid this waste, closed systems should be constantly kept in prime operating order.

There are three methods for moving fluid polymers in an automated system. The first of these, based on the positive displacement piston, is perhaps the best method when a storage or shipping container reservoir is used. Piston pressure, piston/output orifice ratio and piston travel can be modified to accomodate very heavy viscous or non-Newtonian fluids. This method is often employed as a metering device using calibrated cylinder volume; however, if compression occurs, an equalization stop must be utilized before pressure discharge. Often gravity feed is adequate. Positive displacement using gas instead of a piston is also quite common.

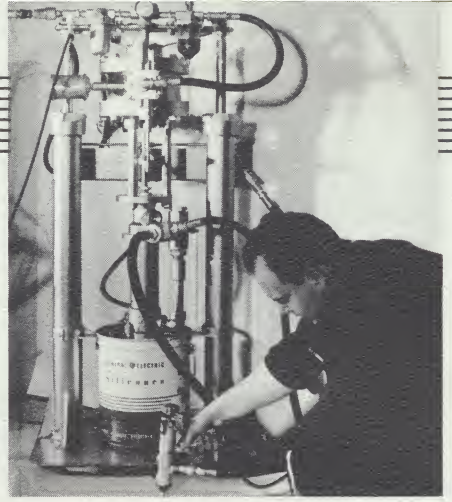
The gear pump is useful where continuous adjustment of input pressure is desired. This method offers good, steady flow rate control without check valve sticking and the need to cycle (necessary with a piston pump). Flow-by and wear are usually identical in both the gas displacement and piston displacement methods; however, some specific combinations of machine design and material cause a lesser degree of wear on the piston pump because of its slower movement and less critical tolerance requirements.

The moving cavity or screw conveyor method works on the same principle as a home meat grinder. It is commonly used for fairly low viscosity fluids and powders of widely varying flow properties in the food packaging industry. Pastes like catsup or RTV-102 can be moved easily by adding a low pressure gas feed to avoid screw cavitation.

Some techniques for applying RTV, but by no means all, include spraying, dipping, flow coating, casting and injection molding. RTV silicone rubbers are readily available in large bulk containers, aerosol packages, collapsible tubes and polyethylene cartridges.

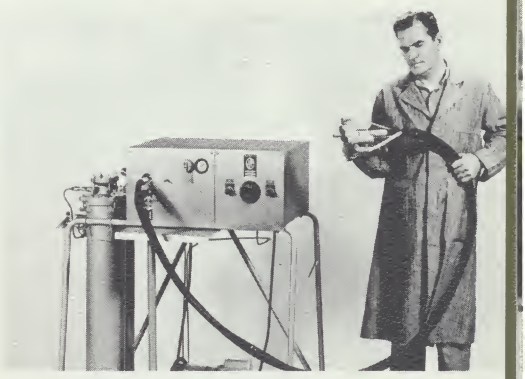
SILICONE RUBBER

Before ordering automatic dispensing equipment, many RTV users have found it advisable to thoroughly familiarize themselves with RTV product charateristics. In some instances, for example, machines have been ordered which were incapable of properly deaerating the liquid silicone material, a critical requirement for most electronic applications. A detailed description of the liquid RTV material, as well as valuable dispensing information is available upon request from the RTV manufacturer. It also has been found helpful to have an accurate estimate beforehand of such factors as available space and tower service, ventilation, part size and shape, adjacent steps in production, dwell time per unit, metering accuracy required, chemical conditions, and cure time.



PISTON DISPLACEMENT pump and metered shot gun. One shown above is manufactured by Pyles Industries, Detroit.

BELL & GOSSETT Company's deaerator-mix in hand gun on 10' flexible hose. Unit requires only 110 or 220 volt power.



EQUIPMENT FOR AUTOMATIC DISPENSING OF RTV SILICONE RUBBER

Bell & Gossett Co. Morton Grove, Illinois Sales Outlet is: Circuit Development Co. P. O. Box 969 Boulder, Colorado	Self contained dispenser for deaerating and mixing in a hand gun on a 10 ft. flexible hose. Requires only 110 or 220 v power. This is an efficient unit widely used for multiple component RTV — costs about $6,000.
United Process Santa Monica, California and Wayne, Pennsylvania	A small batch mixer shot dispenser used in silicone embedding compound application. The company has an excellent line of equipment and considerable liquid plastics experience.
H. V. Hardman Co. Belleville, New Jersey	Firm has considerable experience with multiple component liquid polymers. 500 and 600 series shot dispenser machines use catalyst piston pump and base gear pump; handle two or three components; can be heated, fairly well deaerated. These dispense about ½ gallon/minute; cost is $3-6,000. The newer micro meter system uses a double piston positive displacement device and should meter to 0.004% accuracy.
Automatic Process Control Union, New Jersey	They have built an excellent machine to mix, deaerate and dispense RTV at a rapid rate for automatic molding. They prefer contract work and a typical job will cost $10-20,000 for full automation.
Pyles Industries Detroit, Michigan	Have a large engineering staff. Excellent standard designs and new equipment. Can contract any job. Two component pumps to mix and meter shotwise in large volume. Cost around $10-15,000. Sell cartridge guns and equipment; also systems to pump RTV-102 from 5 to 55 gallon drums through flexible hose to shot or continuous trigger actuated guns. Cost about $1,000.
Semco Sales and Service Inglewood, California	Sell gas pressure and ratchet cartridge guns. Some automatic equipment; much like Pyles Industries.
Gray Pump Co. Minneapolis, Minnesota	A good line of air powered positive displacement pumps and airless spray equipment well tested with all RTV's. Just getting into dispensing and metering. Pumps should be excellent for one component handling and dispensing too.
Diehl-Mateer Philadelphia, Pennsylvania	Screw principle low pressure output one-component RTV silicone rubber dispenser. This small food machinery designer will do a good job on contract work.
Hull Corp. Hatboro (Philadelphia), Pennsylvania	Fair small unit for meter, mix and shot dispensing has been tested on all RTV's and catalysts (pastes and diluted T-12). Reservoir is small and there is no deaeration, but it could be adapted on contract. Cost is about $2,000.
H. S. Bancroft Philadelphia, Pennsylvania	Small company, also a Semco distributor, has an excellent simple design easy to use and maintain (i.e. shot dispenser for premixed or one component polymers). It is designed to work from a Semco tube and could be used with a gravity or pressure feed larger reservoir. This machine is very good for simple, dependable, rapid acting small shot metering. Cost is about $2,000. Bancroft is not equipped for contract design work.
Alemite Co. Chicago, Illinois	A source for cartridge or small reservoir dispensing guns which have been used for one-package RTV silicone rubber.
Lincoln Engineering St. Louis, Missouri	A good source for valves and parts where customer is designing his own unit.
Kenics Corp. Wakefield, Massachusetts	Make small volume liquid polymer metering and dispensing equipment. Have one-component RTV silicone rubber experience.
Martin Sweets Co. Louisville, Kentucky	Have experience dispensing RTV-11 with oil diluted catalyst either as spray or solid stream.

WIN $10

Let GE Send You $10.00 for your RTV Application

(. . . or give you a FREE GIFT for your trouble anyway)

It's so EASY

Just tell us about your RTV application; G-E will pay $10 for each application it uses in an advertisment. Even if you don't win the $10 we'll send you a surprise free gift, anyway and thank you for your trouble.

HERE ARE SOME SAMPLE APPLICATION IDEAS

HERE'S HOW TO WIN!

1. If you are a user of RTV silicone rubber, you are eligible to enter.

2. Just tell us about an application for RTV and either attach it to an official entry blank or mail it on a plain letterhead complete with your name, title, firm name and address. Your application may be one that is in use, in the design stage, a prototype or theoretical. You'll be judged on the suitability of the RTV application for use in a G-E advertisement. Pictures help get your idea across, so send them if you have them.

3. You may enter as many times as you wish. Each entry will be judged independently of the others you submit and may win another of the awards. Decision of the judges is final. General Electric Company reserves the right to use all entries or applications without compensation.

$10.00 FROM G-E CONTEST / *OFFICIAL ENTRY FORM*

SEND TO: $10 FROM G-E CONTEST • GENERAL ELECTRIC CO. • WATERFORD, N. Y.

ENTRY BLANK

(NAME) (TITLE) (FIRM)

(FIRM ADDRESS) (CITY) (STATE)

(HOME ADDRESS) (CITY) (STATE)

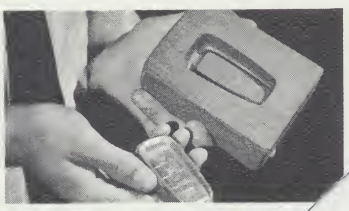
ATTACH DESCRIPTION OF APPLICATION TO ENTER • MAIL BEFORE MIDNIGHT FEB. 15, 1966

CHECK THESE FACTS ABOUT RTV SILICONE RUBBER

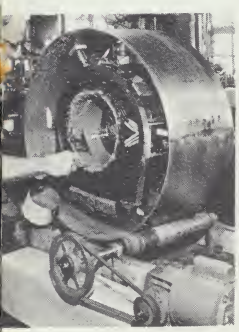
- Resists temperature from —100 to 600°F
- Resists radiation, oxidation
- It's water repellent
- Chemically inert
- Bonds securely

INSULATES

BONDS



REPRODU



SEALS

ELEVEN RTV silicones designed to meet MIL-S-23586

General Electric now offers a full range of RTV silicone compounds designed to meet high performance and reliability requirements for RTV's in aerospace and weapons applications as set forth under MIL-S-23586 (Wep). A new addition to G-E's proven aerospace silicones, the RTV-8000 series includes pourable compounds and spreadable pastes, with the required type and amount of catalyst to permit fast, medium and slow cures.

All compounds cure at room temperature. All have excellent electrical properties. And in common with all G-E RTV silicone rubber compounds, they have excellent resistance to temperature extremes from −90°F to +600°F; they resist ozone, weathering and aging under conditions that break down ordinary elastomers; they resist attack by many oils, solvents and chemicals; and they bond so well after priming that the bond is actually stronger than the rubber itself.

G-E RTV's QUALIFIED UNDER MIL-S-23586 (WEP)

Type I Low Viscosity	Type II Moderate Viscosity	Type III Thixotropic
RTV-8111 Fast Cure	RTV-8262 Med. Cure	RTV-8372 Med. Cure
RTV-8112 Med. Cure	RTV-8223 Slow Cure	RTV-8373 Slow Cure
RTV-8113 Slow Cure	RTV-8243 Slow Cure	RTV-8382 Med. Cure
	RTV-8263 Slow Cure	RTV-8383 Slow Cure

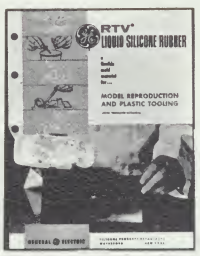
The low and medium viscosity compounds in the new RTV-8000 series are recommended for potting and encapsulating. The high viscosity pastes are recommended for sealing, patching, and caulking, as well as for thermal insulation where a high degree of radiant heat is involved. Like to know more? For complete technical information, write to Section SD-154 Silicone Products Dept., General Electric Co., Waterford, N. Y.

LITERATURE

FIVE Guides to RTV SILICONE RUBBER

■ **ADHESIVE/ SEALANTS —**

Full range of silicone rubber adhesive/ sealants for industrial applications is described in this 8-page, two-color technical data book. (CIRCLE S-2C).



■ **RTV FOR PLASTIC TOOLING —**

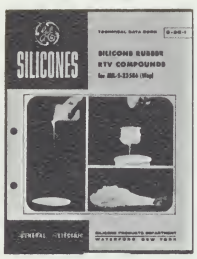
Eight-page publication describes procedures and preparation and selection of materials for casting plastic parts in flexible silicone rubber molds. (CIRCLE CDS-191).

■ **MOTOR ENCAPSULATION —**

Four-page publication describes procedure for encapsulating motor windings with RTV silicone rubber to provide protection similar to totally enclosed motors. (CIRCLE CDS-254).

■ **SILICONES FOR MIL-S-23586 (Wep) —**

This six-page fold-out identifies the largest selection of two-part silicone rubbers offered by the silicone industry to meet MIL-S-23586 (Wep). Each compound in this series is packaged in kit form containing the material with the proper amount and type of curing aegnt. (CIRCLE S-3C-1).



■ **COMPLETE RTV GUIDE —**

Complete description of today's RTV silicone rubbers with full technical data. Publication is two colors, 28 pages. (CIRCLE S-3C-1).

GENERAL ELECTRIC CO. SILICONE PRODUCTS DEPARTMENT, WATERFORD, NEW YORK

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